atomic particles in much the same way as Rutherford probed the inside of the atom (see RUTHERFORD SCATTERING). Such experiments were performed on protons in the late 1960s using high-energy electrons at the Stanford Linear Accelerator Centre (SLAC). As in Rutherford scattering, deep inelastic scattering of electrons by proton targets revealed that most of the incident electrons interacted very little and pass straight through, with only a small number bouncing back. This indicates that the charge in the proton is concentrated in small lumps, reminiscent of Rutherford's discovery that the positive charge in an atom is concentrated at the nucleus. However, in the case of the proton, the evidence suggested three distinct concentrations of charge and not one.

Inequality A relationship between two quantities in which one of the quantities is not equal to (or not necessarily equal to) the other quantity. If the quantities are a and b, two inequalities exist: a is greater than b, written $a > b$, and a is less than b, i.e. $a < b$. Similar statements can take the form: a is greater than or equal to b, written $a \geq b$, and a is less than or equal to b, which is denoted $a \leq b$. There are many applications of inequalities in physical science, an example being the Heisenberg *uncertainty principle.

Inert gases *See* NOBLE GASES.

Inertia The property of matter that causes it to resist any change in its motion. Thus, a body at rest remains at rest unless it is acted upon by an external force and a body in motion continues to move at constant speed in a straight line unless acted upon by an external force. This is a statement of Newton's first law of motion. The *mass of a body is a measure of its inertia. *See* MACH'S PRINCIPLE; INERTIAL FRAME.

Inertial frame A *frame of reference in which bodies move in straight lines with constant speeds unless acted upon by external forces, i.e. a frame of reference in which free bodies are not accelerated. Newton's laws of motion are valid in an inertial system but not in a system that is itself accelerated with respect to such a frame.

Inertial mass *See* MASS.

Inert-pair effect An effect seen especially in groups 13 and 14 of the periodic table, in which the heavier elements in the group tend to form compounds with a valency two lower than the expected group valency. It is used to account for the existence of thallium(I) compounds in group 13 and lead(II) in group 14. In forming compounds, elements in these groups promote an electron from a filled s-level state to an empty p-level. The energy required for this is more than compensated for by the extra energy gain in forming two more bonds. For the heavier elements, the bond strengths or lattice energies in the compounds are lower than those of the lighter elements. Consequently the energy compensation is less important and the lower valence states become favoured.

Infection The invasion of any living organism by disease-causing microorganisms (see PATHOGEN), which proceed to establish themselves, multiply, and produce various symptoms in their host. Pathogens may invade via a wound or (in animals) through the mucous membranes lining the alimentary, respiratory, and reproductive tracts, and may be transmitted by an infected individual, a *carrier, or an arthropod *vector. Symptoms in animals appear after an initial symptomless incubation period and typically consist of localized *inflammation, often with pain and fever. Infections are combatted by the body's natural defences (see IMMUNE RESPONSE). Treatment with drugs (see ANTIBIOTICS; ANTISEPTIC) is effective against most bacterial, fungal, and protozoan infections; some viral infections respond to *antiviral drugs. *See also* IMMUNIZATION.

Inferior Describing a structure that is positioned below or lower than another structure in the body. For example, in flowering plants the ovary is described as inferior when it is located below the other organs of the flower. *Compare* SUPERIOR.

Infinite series *See* SERIES.

Infinitesimal Vanishingly small but not zero. Infinitesimal changes are notionally made in the *calculus, which is sometimes called the infinitesimal calculus.

Infinity Symbol ∞. A quantity having a value that is greater than any assignable value. Minus infinity, $-\infty$, is a quantity having a value that is less than any assignable value.

Inflammation The defence reaction of tissue to injury, infection, or irritation by chemicals or physical agents. Cells in the affected tissue release various substances, including *histamine, *serotonin, *kinins, and *prostaglandins. These cause localized dilatation of blood vessels so that fluid leaks out and blood flow is increased. They also attract white blood cells (lymphocytes) to the site. Overall, these responses lead to swelling, redness, heat, and often pain. White blood cells, particularly *phagocytes, enter the tissue and an *immune response is stimulated. A gradual healing process usually follows.

Inflation *See* EARLY UNIVERSE.

Inflationary universe *See* EARLY UNIVERSE.

Inflection A point on a curve at which the tangent changes from rotation in one direction to rotation in the opposite direction. If the curve $y = f(x)$ has a stationary point $dy/dx = 0$, there is either a maximum, minimum, or inflection at this point. If $d^2y/dx^2 = 0$, the stationary point is a point of inflection.

Inflorescence A particular arrangement of flowers on a single main stalk of a plant. There are many different types of inflorescense, which are classified into two main groups depending on whether the tip of the flower axis goes on producing new flower buds during growth (see RACEMOSE INFLORESCENCE) or loses this ability (see CYMOSE INFLORESCENCE).

Information technology *See* IT.

Information theory The branch of mathematics that analyses information mathematically. Several branches of physics have been related to information theory. For example, an increase in *entropy has been expressed as a decrease in information. It has been suggested that it may be possible to express the basic laws of physics using information theory. *See also* LANDAUER'S PRINCIPLE; SZILARD'S PRINCIPLE.

Infradian rhythm *See* BIORHYTHM.

Infrared astronomy The study of radiation from space in the infrared region of the spectrum (see INFRARED RADIATION). Some infrared radiation is absorbed by water and carbon dioxide molecules in the atmosphere but there are several narrow atmospheric *windows in the near-infrared (1.15–1.3 μm, 1.5–1.75 μm, 2–2.4 μm, 3.4–4.2 μm, 4.6–4.8 μm, 8–13 μm, and 16–18 μm). Longer wavelength observations must be made from balloons, rockets, or satellites. Infrared sources are either thermal, i.e. emitted by the atoms or molecules of gases or dust particles in the temperature range 100–3000 K, or electronic, i.e. emitted by high-energy electrons interacting with magnetic fields as in *synchrotron radiation. Detectors are either modified reflecting *telescopes or solid-state photon detectors, usually incorporating photovoltaic devices (see PHOTOELECTRIC EFFECT).

Infrared radiation (IR) Electromagnetic radiation with wavelengths longer than that of red light but shorter than radiowaves, i.e. radiation in the wavelength range 0.7 micrometre to 1 millimetre. It was discovered in 1800 by William Herschel (1738–1822) in the sun's spectrum. The natural vibrational frequencies of atoms and molecules and the rotational frequencies of some gaseous molecules fall in the infrared region of the electromagnetic spectrum. The infrared absorption spectrum of a molecule is highly characteristic of it and the spectrum can therefore be used for molecular identification. Glass is opaque to infrared radiation of wavelength greater than 2 micrometres and other materials, such as germanium, quartz, and polythene, have to be used to make lenses and prisms. Photographic film can be made sensitive to infrared up to about 1.2 μm.

Infrared spectroscopy (IR spectroscopy) A technique for chemical analysis and the determination of structure. It is based on the principles that molecular vibrations occur in the infrared region of the electromagnetic spectrum and functional groups have characteristic absorption frequencies. The frequencies of most interest range from 2.5 to 16 μm; how-